



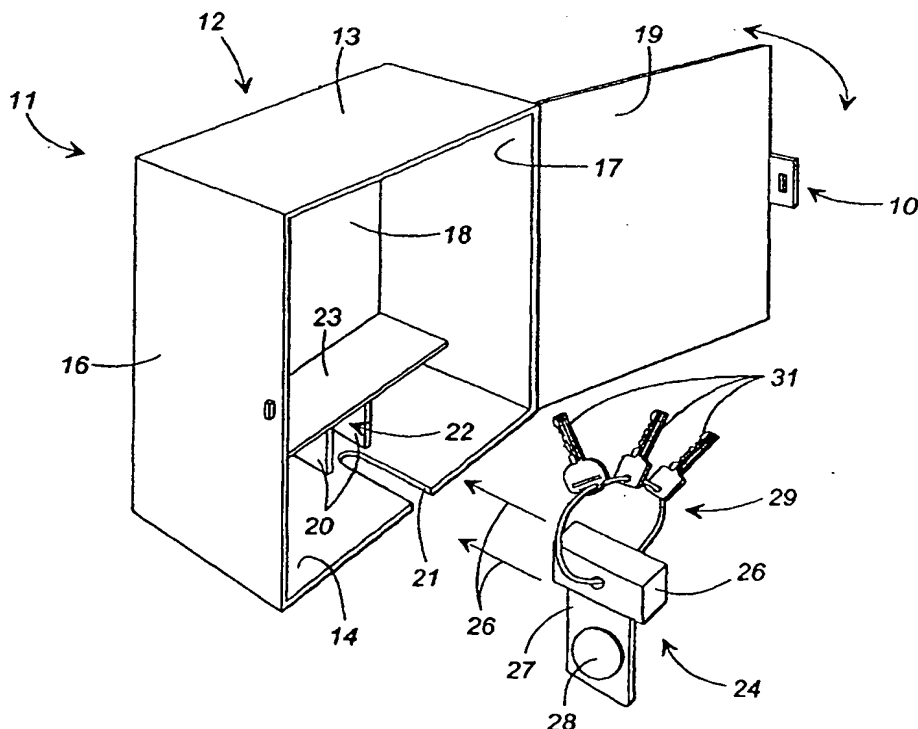
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(54) Title: OBJET CARRIERS FOR AN OBJECT CONTROL AND TRACKING SYSTEM

## (57) Abstract

Object carriers (11, 56, 81) are provided for use with an object (31, 71) tracking and control system of the type having a storage receptacle with a tray (32) provided with an array of slots (33) for receiving ID tags (24) bearing touch memory devices (28). A computer-based controller is provided for detecting the absence or presence and identity of ID tags (24) disposed in the slots (33). The carrier (11, 56, 81) of this invention includes a container (12) with an openable panel (19, 67) for placing objects in and removing objects from the carrier (11, 56, 81). A thin plastic tongue (27, 72) projects from the carrier (11, 56, 81) and bears a touch memory device (28, 73). Carriers (11, 56, 81) bearing objects (31, 71) to be tracked are placed in the storage receptacle with their tongues (27, 72) extending into the slots (33) of the receptacle. The controller can thus detect and log the removal and replacement of the carrier (11, 56, 81) in the storage receptacle. In one embodiment, the opening and closing of the carrier (11, 56, 81) when it is not stored in the receptacle is detected and logged for tracking access to the carrier (11, 56, 81) in more detail.



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**OBJECT CARRIERS FOR AN  
OBJECT CONTROL AND TRACKING SYSTEM**

**REFERENCE TO RELATED APPLICATION**

This application claims the benefit of the filing date of prior filed U. S. provisional  
20 patent application serial number 60/099,954 filed September 11, 1998 (37 CFR  
1.78(a)(4)).

**TECHNICAL FIELD**

This invention relates generally to object tracking and control systems and more  
25 particularly to enhancements usable with such systems for tracking larger or collections  
of keys and loose objects other than keys.

**BACKGROUND OF THE INVENTION**

Many objects have intrinsic value or have value because they provide access to  
30 other valuable objects. For instance, jewelry and coins have inherent and intrinsic value  
while keys, such as keys to vehicles, have value because they provide access to other

valuable objects, namely automobiles and trucks. Further, access to and control of some items, such as narcotics for example, needs to be monitored, tracked, and controlled to assure against unauthorized access or to assure that proper and appropriate access is catalogued. There is a serious need to be able to track, catalogue access to, and control  
5 such objects in a way that is reliable, simple to implement, and virtually tamper proof.

In the past, a variety of systems have been implemented to track and control objects. In the case of keys in an automobile dealership, for example, peg boards have been used to keep track of the keys as salespersons, maintenance personnel, and others remove keys for access to vehicles. Generally, sign-out sheets have been used to log the  
10 check-in and check-out of such keys. Obviously, such a manual system of tracking has numerous shortcomings due in large part to the very real potential of human error and forgetfulness in carrying out the sign-in and sign-out procedures.

More recently, automated computer controlled key tracking systems have been implemented for tracking, for example, vehicle keys at car lots and keys to the apartments  
15 of apartment complexes. One such system particularly applicable to the present invention is the key tracking system disclosed and claimed in my U. S. Patent no. 5,801,628 and my pending U. S. patent application serial number 09/073,757, the disclosures of which are hereby incorporated fully by reference. In this system, referred to herein as the "Key Track" system, keys to a vehicle are attached with a rivet or the like to a thin plastic key  
20 tag having a depending tongue. The tongue carries a small button-shaped electronic touch memory device, which stores a ID code. The tongues of the key tags are configured to be insertable in an array of slots formed in a panel within a storage drawer. A printed circuit back plane is disposed beneath the array of slots and is provided with a plurality of pairs of metal contacts, each pair of contacts being aligned with a  
25 corresponding one of the slots. When the tongue of a key tag is inserted in a selected one of the slots, its touch memory device is engaged by the corresponding pair of contacts.

A computer based controller is electronically coupled through a data matrix to the contacts on the back plane and periodically polls each pair of contacts, preferably several times per second, to determine the presence or absence of a touch memory device and  
30 thus which slots contain key tags and which do not. When a slot contains a key tag, the touch memory device of the tag is read to determine its ID code, from which the identity

of the particular key on the tag can be determined through a table lookup. In this way, the absence or presence and location of the key tags and their associated keys can be noted by the controller each time the array of contacts are polled. If a tag present in a slot on a prior polling is absent on a subsequent polling, then the controller notes that that the tag  
5 and its key has been removed from the storage drawer. Conversely, if a key tag is detected in a previously empty slot, the controller notes that the tag and its key have been replaced in the storage drawer. The removal and replacement of keys is therefore continuously monitored.

An access feature requires an authorized user such a salesperson to enter an ID  
10 code to unlock and access the storage drawer. When the history of removal and replacement of key tags and their keys is combined with other information, such as the time at which tags are removed and replaced and the identities of the persons who accessed the drawer and times of access, access to the keys in the drawer can be controlled and a detailed tracking log can be created. This system greatly decreases  
15 instances of lost keys, reduces the time required to find checked-out keys, and generally provides automatic tracking and control of the keys, and thus, to a large extent, controls and tracks the vehicles to which they provide access.

While the Key Track system described above has proven extremely valuable in the tracking and control of keys, it nevertheless has been limited somewhat in the  
20 situations to which it is readily applicable. For example, the tags used with the system are made of thin relatively flat plastic material that generally provides for the attachment of a single or only a few keys to the tag. It has been difficult to attach a large collection of keys such as keys on a key ring and even more difficult to attach larger special function keys such as keys that incorporate electronic transmitters for locking and unlocking a car  
25 remotely. In these situations, it has been experienced that keys can fall or hang into the slots of the Key Track drawer and short out one or more of the contacts on the backplane, resulting in system errors or failure. While simply providing larger tags is helpful, it has not proven to be a complete solution. Furthermore, the system has generally been poorly applicable to the tracking of loose items such as, for example, jewelry, narcotics, and the  
30 like because such items cannot easily be attached to a tag. The present invention is

intended to enhance and expand the basic Key Track system for application to these and other situations.

Another relative shortcoming of present electronic key tracking systems such as the Key Track system, and object tracking systems in general, has been limitations resulting from the fact that the keys are only detectable upon check-in and check-out at a central storage location. This has meant that tracking of keys has generally been limited to keeping a log of when the keys are physically removed and replaced in a central storage receptacle. The disposition of keys in the interim has not been trackable. Nevertheless, it is clearly useful to track the movement and use of keys and other objects in the interim between the times when they are checked out and checked back in at the central storage location. For example, in the case of tracking use of keys to apartments by maintenance personnel, it is desirable to know not only that a group of keys were checked out and checked back in at particular times, but also when the keys were used in the interim to access apartments. such information can be useful, for example, when claims of theft or vandalism are levied against security personnel. It can also be useful in general security dispatching to insure that security guards check in at all required stations while making security rounds and to log the activities of such guards during their rounds. In the tracking of narcotics at a hospital, it is desirable to know when and by whom particular narcotics are checked out and checked back in and also the time at which the narcotics are accessed in the interim between check-out and check-in times. In this way, confirmation that patients receive the proper prescriptions at the proper times can easily be made by referring to the resulting log of check-out, access, and check in times. The basic Key Track system has not been readily applicable to such situations.

Thus, even though the Key Track system has proven very useful, there exists a continuing need to enhance the system by providing for the tracking of larger and bulkier keys and key collections, by providing for the tracking and control of the use of keys and other articles in the interim between check out and check in, and, in a more general sense, to provide for the tracking and control of larger or loose items such as jewelry and narcotics. It is to the provision of such enhancements and improvements that the present invention is primarily directed.

### SUMMARY OF THE INVENTION

Briefly described, the present invention, in one preferred embodiment thereof, comprises enhancements to the Key Track system disclosed in my U. S. patent no. 5,801,628 to adapt the system for use in tracking and controlling large collections of or bulky keys, such as keys on a key ring or remote access transmitter keys, and in tracking and controlling larger or loose objects other than keys. The heart of the enhancement is a carrier or box adapted to contain a ring of keys, a larger electronic access key, or objects other than keys, such as, for example, jewelry or narcotics. In one embodiment, the carrier comprises a rectangular box-shaped container with an openable door panel on one side. The door panel may be hinged for access to the container or may be displaceably or removably attached in another way such as by sliding attachment slots. In one configuration for use with keys on a key ring, the container has a slot on its bottom side and the key ring is provided with an ID tag having a relatively thin plastic tongue carrying a touch memory device. In use, the container is opened and the key ring is placed in the container with its ID tag extending through the slot in the bottom of the container. The container is then shut to contain the key ring and its keys whereupon the entire container can be selectively placed in and removed from the Key Track drawer with the protruding ID tag extending into one of the key tag slots in the drawer. The key ring is thus tracked and access to it controlled in the same manner as a single key attached to a traditional key tag.

To facilitate the alignment of containers with slots in the Key Track drawer, an overlay formed of stamped metal or a wire grid can be attached within the Key Track drawer overlying the slots. The overlay defines an array of openings, each sized to receive a container. The openings are positioned such that when a container is slid into one of the openings, the protruding ID tag is directed into one of the slots in the drawer allowing the controller to read the presence of the ID tag and its key ring within the drawer.

Another embodiment of the invention is intended for use with bulky keys having built in remote entry transmitters or with remote entry transmitters not combined with keys. It has previously been difficult to attach such items to a key tag in the traditional key track system. A smaller container, preferably made of molded plastic, is sized to

contain a remote entry key or transmitter. The container comprises rectangular box having an open side for access. A tongue, similar to the tongues on the key tags of the Key Track system, is fixed to the bottom wall of the container and depends therefrom. A touch memory device is carried by the tongue and the tongue is configured to be inserted into the slots in the Key Track drawer. A sliding panel is adapted to slide onto the container from the bottom side thereof and to cover the open side for closing the container and capturing a key in the container. When a key is closed in the container, the container can be placed in one of the slots in a Key Track drawer with its tongue and touch memory device extending into the slot in the traditional way. The attached controller is thus able to detect and track the insertion and subsequent removal of the container from the drawer. Since the sliding panel is slid onto the box from the bottom to close the container, the panel cannot be removed for access to the key without first removing the container from the Key Track drawer, which will be detected by the controller. Thus, since the keys cannot be removed without detection, a measure of security for relatively expensive remote entry transmitters and keys is provided. In addition, since the key is closed within the container, it is protected and its identity cannot be determined simply by looking into the Key Track drawer. Only the controller is able to identify the location of a particular key within the drawer upon a proper query by an authorized user.

In yet another embodiment of the invention, the carrier and Key Track system are enhanced to expand the system beyond its traditional use for tracking keys to a general object tracking and control system. This embodiment is particularly useful for tracking valuable objects such as jewelry or for tracking the use of controlled substances such as narcotics and medication. A set of containers is provided, each container having a box with an open side and a hinged panel that covers the open side and closes the container. The container is provided with a slot or pocket in which a printed circuit board can be slid. The printed circuit board carries a memory device storing a ID code and may also carry other components such as a microcontroller, ancillary memory, an RF transmitter, an RFID tag, and related components. Conductive pads on the printed circuit board are coupled to the components on the board for electronically accessing the components.



A drawer or other storage receptacle is provided for receiving the containers of this embodiment. The drawer has an overlay panel formed with an array of openings or bays each sized to receive one of the containers. A printed circuit back plane is disposed behind the overlay panel and has a plurality of sets of conductive contacts, each set of contacts positioned to engage the conductive pads of a container's printed circuit board when the container is inserted into the corresponding bay. The contacts are wired in a data matrix, which is connected to a computer-based controller as in the traditional Key Track system. Use of this embodiment is similar to use of the traditional Key Track system. The controller detects and logs the removal and replacement of containers in the drawer by reading the ID codes of the memory devices associated with the containers.

This embodiment also may include a further enhancement wherein the printed circuit boards in the containers are more sophisticated and are configured to log the opening and closing of the container between the times when it is checked out and checked back in at the storage drawer. The container may also be provided with sensors to gather other information in the interim period such as, for example, the times when the container passed location transmitters, identification numbers from patient arm bands or ID buttons, or other information. This information can be downloaded to the controller upon check in and correlated with other information to provide valuable data compilations and reports. Such information is useful, for example, in the dispensing of drugs to patients in a hospital, where it is desired to log when the drugs are checked out, by whom, at what times the container was opened while checked out for access to the drugs stored inside, and the identities of patients provided with drugs. This information can be correlated to medication schedules for patients to insure that patients are being provided with the proper drugs at the proper times.

The printed circuit boards of this embodiment can be even further enhanced with simple RF transmitters and/or RFID tags available from a variety of manufacturers. RFID tags are adapted to transmit a code and/or other information to a receiver coupled to the computer-based controller and can be used as an alternative to touch memory devices. Other RF transmitters can be provided if desired to transmit a code upon the occurrence of prescribed events such as, for example, each time the door of the container is opened

and its contents accessed. Such functionality provides for real time tracking of access to the container in the interim between check-out and check-in times.

Thus, an improved and enhanced method and system for tracking and controlling keys and other objects is now provided. The traditional Key Track system is enhanced to  
5 accommodate large numbers of keys on a key ring, bulky or unusually shaped keys and remote entry transmitters, and valuable or controlled loose objects other than keys. In one embodiment, object containers are provided with active electronics, which tracks and logs access to the container between the times when it is check out and checked back in. In another embodiment, an RF transmitter or RFID tag is provided for radio frequency  
10 communication to the controller. These and other features, objects, and advantages of the invention will become more apparent upon review of the detailed description set forth below taken in conjunction with the accompanying drawing figures, which are briefly described as follows.

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#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a perspective view of a closable carrier usable with the Key Track system to store and track large numbers of keys on a key ring.

Fig. 2 illustrates the carrier of Fig. 1 inserted in one of the slots of a tray of the Key Track system.

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Fig. 3A illustrates a guide or overlay usable with the Key Track system and carrier of Fig. 1 to align and secure the carrier, prevent its opening while mounted in the tray, and to partition the slots of the tray to receive multiple carriers.

Fig. 3B illustrates another embodiment of the container guide in the form of a wire grid defining slots for receiving and aligning carriers.

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Fig. 4 is a perspective exploded view of an alternate embodiment of the carrier for use with the Key Track system when it is desired to track unusually shaped or sized keys, such as keys incorporating remote entry transmitters.

Fig. 5 is a perspective partially cut-away view of an embodiment of the invention in the form of an object tracking system for tracking objects such as jewelry or narcotics.

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Fig. 6 is a perspective partially exploded view of the carrier of the embodiment of Fig. 5 illustrating the removable printed circuit board thereof.

Fig. 7 is a functional electronic schematic diagram showing a preferred circuit for use with the embodiment of Fig. 5.

Fig. 8 is an exploded view illustrating the mounting of a touch memory device in a conducting rather than a non conducting tag.

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### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Referring now in more detail to the drawings, in which like numerals refer to like parts throughout the several views, Fig. 1 illustrates a carrier for ringed keys that embodies principles of the invention in one preferred form. The carrier 11 comprises a generally rectangular box-shaped body 12 formed by a top panel 13, a bottom panel 14, a left side panel 16, a right side panel 17, and a back panel 18. A front panel 19 preferably is hinged along one side to the edge of the right side panel 17 (or, alternatively to the left or any other side panel) to provide a selectively closable hinged door on the carrier.

Locking tabs 30 and 35 preferably are provided on the door and box. The locking tabs have holes that align with one another when the hinged door is closed. A lock or tamper evident ring can be inserted through the aligned holes. In this way, the carrier can be locked shut if desired so that only authorized personnel may access its contents. Alternatively, a tamper evident ring that, when cut, indicates that the carrier has been accessed may be provided. Finally, the carrier preferably is provided with an appropriate latch 10, which may be any suitable form of latch, for releasably latching the door shut when closed to hold the key ring securely in place.

The bottom panel 14 is provided with a slot 21 that extends from the front edge of the bottom panel to a position inwardly spaced from the front edge. A lateral partition 23 spans the left and right side panels and a pair of guide walls 20 extend between the partition 23 and the bottom panel 14 straddling the location of the slot 21 to define a guide slot 22 between the guide walls 20.

An ID tag 24 is adapted to be received in the guide slot 22 and comprises a head 26 from which a relatively thin tongue 27 depends. The head 26 is sized and shaped to slide, as indicated by arrows 25, into and fit partially within the guide 22 with its tongue 27 projecting downwardly through the slot 21. The tongue 27 may be formed of plastic if desired but also may be formed of a more durable and tamper resistant material such as

stainless steel or aluminum. A tongue of stainless steel or aluminum renders the ID tag much less susceptible to tampering or defeat by cutting the ID tag and absconding with the keys, although it requires electrically isolated mounting of the touch memory device as described in more detail below. The location of the ID tag in the slot as described also serves to locate the key ring and the keys attached thereto in the upper portion of the carrier. In this way, the keys are isolated from the tag, are held in place in an organized fashion, and do not interfere with operation of the touch memory device.

The head 26 of the ID tag is adapted to be mounted on a key ring with a group of keys 31 (only a few of which are shown in Fig. 1 for clarity) and includes a hole for this purpose. A touch memory device, such as DS1990A touch memory device available from Dallas Semiconductor, is attached to and carried by the tongue 27 in a manner similar to that in which touch memory devices are carried by the key tags in the standard Key Track system. If the tongue 27 is made of plastic or other electrically insulating material, the touch memory device, which has a radially projecting rim at one end, is simply pressed through an appropriately sized hole in the tongue and secured with a mounting ring. In the event the tongue is made of steel, aluminum, or another conducting material, it may be necessary first to install an insulating spacer and then the touch memory device to insulate the touch memory device from the conductive mounting material of the tongue (see Fig. 8). In either case, the touch memory device is carried by the tongue as shown.

In use, the key ring 29 and keys 31 are placed in the carrier 11 as indicated by arrows 25 with the head 26 of the ID tag 24 being inserted into the guide 22 such that its tongue 27 projects downwardly from the container 12 through the slot 21. When so inserted, the keys and key ring reside in the upper portion of the carrier above the location of the partition 23 and the tongue 27 with its touch memory device projects downwardly from the bottom panel 14 through the slot 21. The front panel 19 can then be hinged shut to enclose and contain the keys and keep them from flopping about. The front panel can be releasably latched shut with latch 10 if desired and a lock or tamper evident ring can be installed in the locking tabs 30 and 35 for enhanced security.

When the front panel 19 is closed, the carrier 11 with keys inside forms a rectangular box as illustrated in Fig. 2 with the tongue 27 of the ID tag projecting downwardly from the

bottom panel 14 of the box. The carrier can then be inserted into a Key Track tray 32 with the tongue of the ID tag extending into one of the slots 33 of the tray to engage the touch memory device with the pair of electrical contacts corresponding to the slot. The ID code stored in the touch memory device can then be read by the attached computer-based controller to determine the presence and location in the tray of the keys associated with the ID tag and to determine when the carrier and its keys are removed. The process, structure, and electronics for reading the touch memory device is described in detail in my U. S. patent no. 5,801,628 and also disclosed in the manufacturer's specifications and thus need not be described in detail here.

It will be noted from Fig. 2 that, when the carrier of the illustrated embodiment is inserted in a selected slot of the key track storage tray 32, the carrier covers the two slots of the tray on either side of the slot in which its ID tag extends, rendering these slots unavailable for use by other key tags or carriers. While the carrier is shown to cover two slots in Fig. 2, it will be understood that less or more slots might be covered and rendered inaccessible depending upon the size of the carrier. This does not represent a particular disadvantage, however, since the controller will simply read that the covered slots are unoccupied and key tags inserted in other available slots will still be detected and identified when they are present. Although a Key Track drawer will accommodate fewer carriers than traditional key tags, the advantage of tracking and controlling large numbers of keys on key rings in the same way that single keys on key tags are tracked far outweighs the disadvantage of any reduced capacity of the drawer. As detailed below, custom overlays or custom trays may also be used to accommodate the carriers if desired. Further, additional drawers can be added to the system as need to accommodate larger numbers of key tags and carriers and any mix of object carriers and key tags can be used with the existing drawer configuration of the Key Track system.

Fig. 3A illustrates an enhancement of the carrier system of Figs. 1 and 2. Here, an overlay or guide 36 is provided for covering a row of slots 33 in the Key Track tray and providing a positioning guide for a plurality of carriers 11. The guide 36, which can be formed of punched and bent sheet metal, comprises opposed sides 37 and opposed ends 38 (only one end is visible in Fig. 3) that form a generally rectangular box shaped structure. A flange 39 is provided at the bottom of each end 38 and holes 41 are bored in

the flange for attaching and securing the guide 36 to the Key Track tray 32. The top 40 of the guide 36 is formed to define at least one socket or receptacle 42 that is sized to receive the carrier 11 therein. Preferably, the receptacle 42 is provided with guide flanges 43 projecting downwardly therefrom to guide the carrier 11 into the receptacle when it is  
5 inserted therein as indicated by arrows 46.

Additional receptacles 44 are also provided in the guide 36 extending therealong and defining an array of carrier receptacles. The guide 36 thus functions to provide an array of receptacles for receiving carriers 11 with each socket properly aligning its respective carrier with a selected slot 33 in the Key Track tray. In addition, the  
10 receptacles hold the hinged front panels 19 of the carriers shut when they are in position within the receptacles. This is important because it prevents a thief from opening the receptacle without first removing it from the tray, which will be detected by the controller. If an unauthorized removal is detected by the controller, appropriate alarms can be generated and actions taken to alert security personnel. Thus, an extra measure of  
15 security is provided by the overlay.

Fig. 3B illustrates an alternate embodiment of a carrier guide or overlay for attachment to a Key Track tray to partition the tray into receptacles for receiving carriers. In this embodiment, the tray 32 of a key track drawer is shown with an array of slots 33 for receiving tongues of key tags bearing touch memory devices. A carrier 11, as  
20 previously described, is formed of a box 16 and a closable hinged door 19. A tongue 27 depends from the carrier and bears a touch memory device 28. a wire frame guide 141 is formed with spaced apart elongated rails 142 bridged by a set of spaced apart connecting segments 144. The rails 142 and connecting segments 144 define an array of rectangular receptacles, each sized to receive a carrier 11, as indicated by the arrows in Fig. 3B.

Vertically depending legs 146 project downwardly from the rails 142 and 143 and are anchored to the key track tray with appropriate fasteners such as shoulders and bolts. The legs 146 secure the wire frame guide to the key track tray and properly position the rectangular receptacles so that when a carrier 11 is inserted into one of the receptacles, the tongue 27 thereof is directed into one of the slots 33. Thus, the wire frame guide  
25 performs a function similar to that of the guide of Fig. 3A, but with a less expensive wire frame structure. Further, since the wire frame is more open than a bent metal guide, the  
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slots 33 can be used with traditional key tags when not holding a carrier and much better visibility is provided for visually identifying the objects in the tray . A simple two row guide is shown in Fig. 3B. It should be understood, however, that multiple row guides are possible and within the scope of the invention. Indeed, the entire key track panel could be overlaid with a wire grid allowing insertion of carriers and/or key tags in any combination. Further, the use of guides such as those illustrated in Figs. 3A and 3B allows the carriers of this invention to be used with vertically oriented panels and backplanes that may be, for example, mounted on a wall. More efficient storage configurations are therefore possible.

Fig. 4 illustrates another carrier for use with the Key Track system. This carrier is designed to allow odd shaped, bulky, or expensive keys to be tracked with the key track system in the same way as a loose key attached to an ID tag. These types of keys include keys, such as key 71, with large heads that incorporate transmitters for remotely locking and unlocking the doors of a vehicle to which they correspond. Remote door lock transmitters not incorporated into the vehicle key can also be tracked as well as other small items. The carrier 56 comprises a case 57, which can be made of molded plastic or other appropriate material. The case 57 is formed by a right side panel 58, a left side panel 59, a top panel 61, a bottom panel 62, and a back panel 63, which, in the preferred embodiment, are unitarily molded of plastic. The side panels 58 and 59 are formed with respective grooves or races 64 and 66 that extend along the outside top edges thereof. The grooves 64 and 66 are shaped and sized for slidably receiving a sliding cover 67 having depending sides or skirts 68 on three sides thereof. Inwardly opposed ribs (not visible in Fig. 4) are formed on the inside portions of the side skirts 68 and are sized and positioned to slide into the grooves 64 and 66 when the sliding cover 67 is moved onto the case 57 as indicated by arrows 69. In this way, the case can be closed with a key or other item inside by sliding the cover onto the case.

An ID tab 72 is provided with a touch memory or other ID device 73 and is secured at one end to the bottom panel 62 of the case 57. The ID tab is sized and configured to be inserted into a selected slot of a Key Track tray. In use, a key 71 is placed in the carrier and closed therein by sliding the sliding cover 67 into place. Preferably, the key is secured to the box with a loop of cabling or other appropriate tether

(not shown) to prevent the box from becoming separated from its key. The carrier is then stored on the Key Track tray by inserting its ID tab into a selected slot of the tray. The Key Track controller can then track and control access to the key within the carrier in the usual way. Preferably, the carrier 57 is sized to take up no more than one space on the Key Track tray so that other key tags or carriers can be inserted into adjacent slots of the tray.

The carriers of figs 1 through 4 have been described in terms of the storage and tracking of keys. It will be clear to those of ordinary skill in the art, however, that a wide variety of items can be stored in the carriers and thus tracked by the key track controller. For example, use of these carriers might convert a car key tracking system into a system for tracking jewelry, narcotics, or other small valuable or dangerous items. An added advantage when tracking such items is that the items are concealed and hidden within their carriers. According, only the Key Track controller is able to inform an authorized user of the location within the drawer of each item. An unauthorized user or would be thief cannot simply look into a drawer full of carriers and locate any particular item. Other uses for the carriers of this invention might be conceived by those of skill in the art such that, clearly, the present invention is not intended to be limited just to the storage and tracking of keys.

Figs. 5 and 6 illustrate an object tracking and control system that embodies principles of the present inventions in yet another form. The object tracking system illustrated in these figures can be used to store, monitor, and track a wide variety of items from automotive keys and apartment keys to narcotics and jewelry, to important files or papers. The system comprises a carrier 81 that, in the illustrated embodiment, is a rectangular box, for containing items to be tracked and controlled. The carrier 81 is sized to be received in a rectangular socket 82 formed in the surface of a receptacle panel 83. The panel 83 may be formed with a large array of receptacles for receiving and continuing a corresponding large number of carriers.

A back plane 84 is mounted behind or beneath the receptacle panel 83 and preferably is spaced therefrom a distance substantially equal to the height of the rectangular carrier 81. In this way, when the carrier is inserted into the receptacle 82 to the back plane, its top panel 86 is substantially flush with the surface of the receptacle



panel 83. As described in more detail below, this configuration inhibits a thief from removing the carrier from the receptacle panel by force.

It will be understood that while only one receptacle and one carrier is illustrated in Fig. 5 for clarity of description, a complete system preferably would include a receptacle panel formed with an array of a plurality of receptacles for receiving a plurality of carriers.

In addition to its top panel 86, the carrier 81 is formed with a bottom panel 87, a left side panel 88, a right side panel 89, a back panel 91, and a hinged front panel 92 (Fig. 6). The back panel 91 in the preferred embodiment is formed with a slot or pocket 108 that extends from the bottom panel 87 to the top panel 86. The pocket 108 has an opening 96 formed therein adjacent the bottom panel of the carrier. The pocket is sized to receive and hold a relatively narrow printed circuit board 93 with a portion of the bottom edge of the printed circuit board exposed through the opening 96 for purposes described in more detail below.

The lower left-hand corner of the carrier 81 is formed with a latch 99 defined by a sloped strike 101 and an indentation 102. A solenoid and plunger assembly 103 is mounted to the back plane 84 at a position adjacent the location of the latch 99 by means of an appropriate mounting bracket (omitted from Fig. 5 for clarity). The assembly 103 includes a plunger 104 that is spring biased to its extended position (the spring assembly is not shown in Fig. 5 but spring biased solenoid assemblies are available commercially, are well known to those of skill in the art, and can be retracted by application of a control voltage to the solenoid.) The strike 101 formed on the carrier is positioned to engage and retract the spring biased plunger 104 of the solenoid 103 when the carrier is inserted into the receptacle 82. When the carrier is fully inserted, the plunger 104 snaps into the indentation 102 to lock the carrier in place within the receptacle. The carrier can be released with an appropriate control signal from the controller to retract the plunger 104 from the indentation 102. Thus the strike and plunger form an electronically releasable lock that secures the carrier in place in its receptacle until an appropriate signal is provided by the controller. Similar locks can also be provided with the carrier embodiments of Figs. 1 through 4 if desired.

A leaf spring or other spring 107 preferably is provided for exerting upward biasing force on a carrier locked in the receptacle. In this way, when the carrier is released by applying an appropriate control signal to the solenoid 103 to retract its plunger, the leaf spring causes the carrier to "pop" up out of the receptacle so that it can be grasped for removal.

As illustrated in Fig. 5 and perhaps best seen in Fig. 6, the circuit board 93 within the pocket 108 is etched to expose a set of conductive pads 94 positioned to be exposed through the opening of the pocket 96 when the circuit board is in place therein. A set of corresponding contacts 97 (Fig. 5) are fixed to the back plane 84 and are positioned for electrically contacting the conducting pads 94 when the carrier is inserted completely into the receptacle 82. The contacts 97 are coupled through a data matrix or other appropriate communications buss to a remote computer-based controller as described in my prior U.S. patent for connecting the electronic components of the circuit board to the controller.

Referring now to Fig. 6, the carrier 81 is illustrated with its hinged front panel 92 (which may also be a sliding or other appropriate type of panel) open and with the circuit board 93 displaced from the pocket 108 of the carrier. Arrows 112 indicate insertion of the circuit board 93 into the pocket 108. Once a circuit board is inserted and locked into place within a carrier, it becomes associated with the carrier and thus associated with articles stored in the carrier.

The circuit board 93 carries integrated circuit components for performing the method of the invention. In one embodiment, for example, the circuit board 93 is provided with a touch memory chip such as the touch memory devices provided on ID tags as discussed above. In this case, the chip preferably is surface mounted to the board to save space rather than being housed in a metal case or button. However, the primary function of the memory chip remains the same; that is, to store and transmit its unique internal code when appropriately polled with a polling signal. The memory chip is electrically coupled to the conducting pads 94 at the bottom of the circuit board and the contacts 97 on the back plane are configured and positioned to engage the conductive pads for receiving the ID code of the memory device and transmit it through the data matrix to the controller for detecting the absence or presence and location of the associated carrier within one of the receptacles.

Alternatively, the circuit board might be provided with more sophisticated electronics including a microcontroller or microprocessor 118 and associated components including a crystal 121 and battery 119. A wide variety of configurations are possible and a simple circuit is depicted in Fig. 6 for clarity. The microcontroller, which includes  
5 internal memory, may be coupled to an integrated circuit RF transmitter that can be actuated by the microcontroller. A reed switch 113 can be coupled to the front panel of the carrier for communicating a signal to the microcontroller 118 whenever the front panel 92 of the carrier is opened or closed. A light emitting diode (LED) 98 is provided at the top of the circuit board 93 and projects through an opening 111 in the top of the  
10 carrier when the board is inserted into the pocket 108. Preferably, the microcontroller is programmed to light the led whenever the carrier is selected by the system controller of the tracking system. In this way, a user can easily find a selected carrier by identifying the carrier to the controller, whereupon the controller lights the LED of the selected carrier and releases it by actuating the appropriate solenoid.

15 The embodiment of Figs. 5 and 6 has many and varied applications. For example, the microcontroller 118 preferably is programmed such that, during the time the carrier is removed from its storage location, a record is kept in the memory of the microcontroller of the times when the hinged front panel of the carrier is open or closed. When the carrier is returned to its storage location, this stored data is downloaded and becomes a record of  
20 the use of the carrier and its contents between the times it was checked-out and checked back in.

Alternatively, the microcontroller can be programmed to activate the RF transmitter at intermittent times while the carrier is checked out or to activate the transmitter whenever the door of the carrier is opened or closed. This information, when  
25 transmitted back to the main computer based controller, can be tallied in real time as a means of tracking use of the contents of the carrier. These capabilities are useful in a wide variety of situations such as, for example, to track not only when medication was checked out to give to a patient, but the time at which the carrier was opened to administer the medication. Questions about medication delivery can thus be readily  
30 answered. A wide variety of other sensors and data gathering capabilities can be provided in such a carrier embodiment including, but not limited to, biometrics

information, time and ambient temperature information, information gathered through data ports, and information from various types of on board switches. Further, with on board intelligence, enhanced substantially autonomous functionality is possible. For example, the carrier may be provided with an internal lock that is activated only when an authorized user has checked out or attempts to open the carrier.

Another use of the embodiment of Figs. 5 and 6 is in tracking keys to an apartment complex. One carrier might, for example, house keys to an entire floor of apartments with each key coupled to the microcontroller so that the microcontroller can detect when a specific key is removed. A detailed record of when the key set was checked out and when each specific key was removed from the carrier is thus easily maintained for use in verifying when personnel had access to particular apartments. The use of RF transmitters associated with objects expands the effectiveness of tracking systems greatly.

Fig. 7 is a functional schematic diagram of a circuit usable in the implementation of the the embodiment of Figs. 5 and 6. The circuit comprises an addressable switch in the form of an integrated circuit coupled to the ground, data, and Vin pads of the circuit board. The switch can be a DS2074 or other appropriate commercially available chip if desired. I/O 1 of the addressable switch 140 is coupled through an LED 141 and a current limiting resistor 142 to supply voltage Vin. As an alternative to drawing Vin from the backplane of an object tracking system, a battery 143 can be provided on the circuit board, in which case only two pads 94 (Fig. 6), one for a data line and one for a ground, are required. I/O 2 of the addressable switch 140 is coupled to an on board sensor, which may be a loop detector sensor to detect when an object is removed from the carrier, a reed switch to detect opening of the carrier, of another type of sensor depending on the intended use of the system. Other I/O ports of the switch preferably are coupled to other switches or elements, such as locks, latches, etc. In use, data can be provided to or read from the addressable switch 141 through the backplane of an object control system. In this way, the central controller of the system is able to download information from the switch regarding events recorded in the interim between check out and check in of the carrier, upload instructions to the carrier to, for example, turn on its LED, unlock its cover, or otherwise.

Fig. 8 illustrates a preferred method of attaching or mounting a touch memory device to a steel, aluminum, or other conducting plate material, which may be used instead of a plastic tongue for added security. An opening is formed in the conductive mounting material 150 and the opening is sized for receiving an insulation spacer 152 through which a touch memory ID button is received. An insulating washer 153 is secured around the touch memory button on the other side of the mounting material and a crimp ring is secured around the touch memory button to secure it firmly in place within the opening. In this way, touch memory buttons can be mounted in metal tags for added security while remaining electrically isolated from the tags, which is required for proper operation.

The invention has been described herein in terms of preferred embodiments and methodologies. It will be obvious to those of skill in the art, however, that various additions, deletions, and modifications might well be made to the illustrated embodiments without department from the spirit and scope of the invention as set forth in the claims.

CLAIMS

What is claimed is:

- 5           1.     An object carrier assembly for use with an object control and tracking system wherein a storage receptacle is provided with an array of slots for receiving identification tags bearing touch memory devices and a controller for determining the absence or presence and identity of identification tags disposed in the slots, said object carrier assembly comprising:
- 10           a container having an opening for accessing the interior of the container to place objects in the container and remove objects from the container;
- a panel adapted to cover said opening to close objects within said container; and
- a tongue projecting from said container when an object is disposed therein, said tongue bearing a touch memory device storing a ID code identifying an object within said
- 15           container and being insertable in a selected slot of the tray for detection and identification by the controller.
2.     An object carrier assembly as claimed in claim 1 and wherein said container is generally rectangular having one open side defining said opening.
- 20           3.     An object carrier assembly as claimed in claim 2 and wherein said panel is hingedly attached to said container and is hingable between a closed position closing said container and an open position opening said container.
- 25           4.     An object carrier assembly as claimed in claim 2 and wherein said panel is attachable to said container to close said opening and displaceable to said container to open said opening.
- 30           5.     An object carrier assembly as claimed in claim 4 and wherein said panel is slidably attachable to said container to cover and close said opening.

6. An object carrier assembly as claimed in claim 1 and wherein said container is formed with a narrow slot and wherein said tongue is fixed to an identification tag attached to an object in said container, said tongue extending through said narrow slot to project from said container when the object is contained therein.

5

7. An object carrier assembly as claimed 1 and wherein said tongue is attached to said carrier and projects therefrom.

8. An object carrier assembly as claimed in claim 1 and further comprising a guide member associated with said storage receptacle, said guide member defining openings sized to receive said container and being positioned to direct said tongue into a selected slot of storage receptacle when said container is inserted into one of said openings.

9. An object carrier assembly as claimed in claim 8 and wherein said guide member is formed of sheet metal.

10. An object carrier assembly as claimed in claim 8 and wherein said guide member is defined by a wire frame.

20

11. An object control and tracking system comprising:  
at least one carrier for receiving and containing objects to be tracked;  
a memory device on said carrier, said memory device storing a ID code identifying said carrier;  
conductive pads on said carrier coupled to said memory device for accessing stored information therein;  
a storage unit defining an array of receptacles sized to receive said carrier;  
an array of sets of electrical contacts underlying said receptacle panel, each set of electrical contacts being associated with a respective one of said receptacles and being positioned to engage said conductive pads of said carrier when said carrier is inserted into said receptacle; and

25

30

a controller coupled through a communications link to said electrical contacts, said controller being programmed to access the memory devices of carriers disposed in receptacles of said storage unit to determine the absence or presence and identity of carriers in the storage unit.

5

12. An object control and tracking system as claimed in claim 11 and further comprising a locking mechanism associated with each receptacle for releasably locking said carrier in place when said carrier is inserted in a receptacle, said locking mechanism being coupled to and controllable by said controller for selective release of said carrier.

10

13. An object control and tracking system as claimed in claim 11 and further comprising a switch for detecting the opening and closing of said carrier when said carrier is not disposed in one of said receptacles, said memory device storing the detected opening and closing events.

15

14. An object control and tracking system as claimed in claim 13 and further comprising a microcontroller on said carrier coupled to said memory device and to said switch for monitoring opening and closing of said carrier and storing information relevant thereto in said memory device.

20

15. An object control and tracking system as claimed in claim 14 and wherein the information stored in said memory device relevant to opening and closing of said carrier is transferred to said controller upon placement of said carrier into one of said receptacles.

25

16. An object control and tracking system as claimed in claim 14 and further comprising a transmitter on said carrier coupled to said microcontroller and a receiver coupled to said main controller, said transmitter transmitting in real time to said receiver information relevant to the opening and closing of said carrier when said carrier is not disposed in one of said receptacles.

30



17. A method of tracking access to an object, said method comprising the steps of:

- (a) placing the object in a carrier;
- (b) placing the carrier in a storage location;
- 5 (c) detecting and logging the presence of the carrier at the storage location;
- (d) detecting and logging the removal of the carrier from the storage location;
- (e) repeating steps (c) and (d) each time the carrier is placed in and removed from the storage location and compiling the logged information as a record of access to the object in the carrier.

10

18. The method of claim 17 and further comprising the steps of detecting and logging information relevant to the condition and use of the carrier in the interim between removal of the carrier from the receptacle and replacement of the carrier back into the receptacle and combining this logged information with the logged information relevant to  
15 removal and replacement of the carrier as a more detailed record of use of the object in the carrier.

15

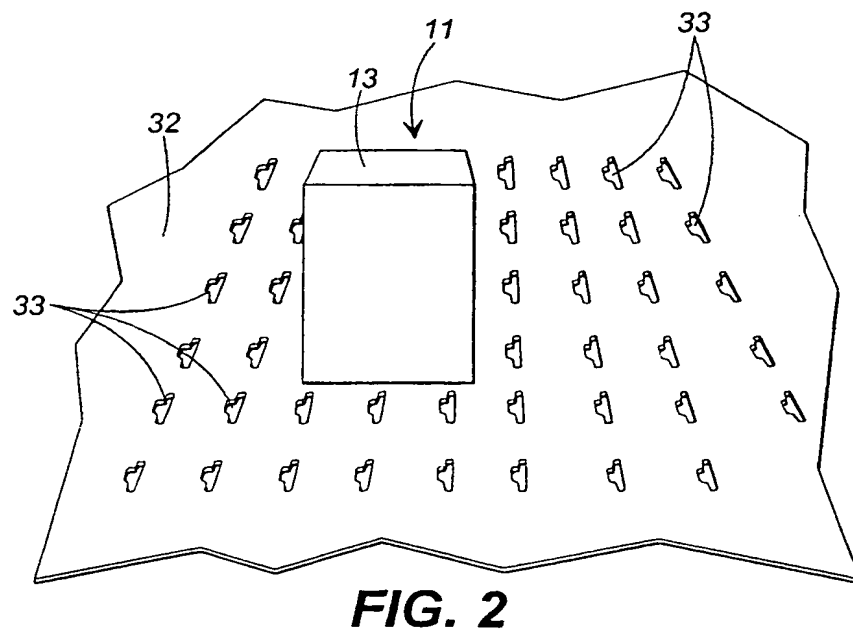
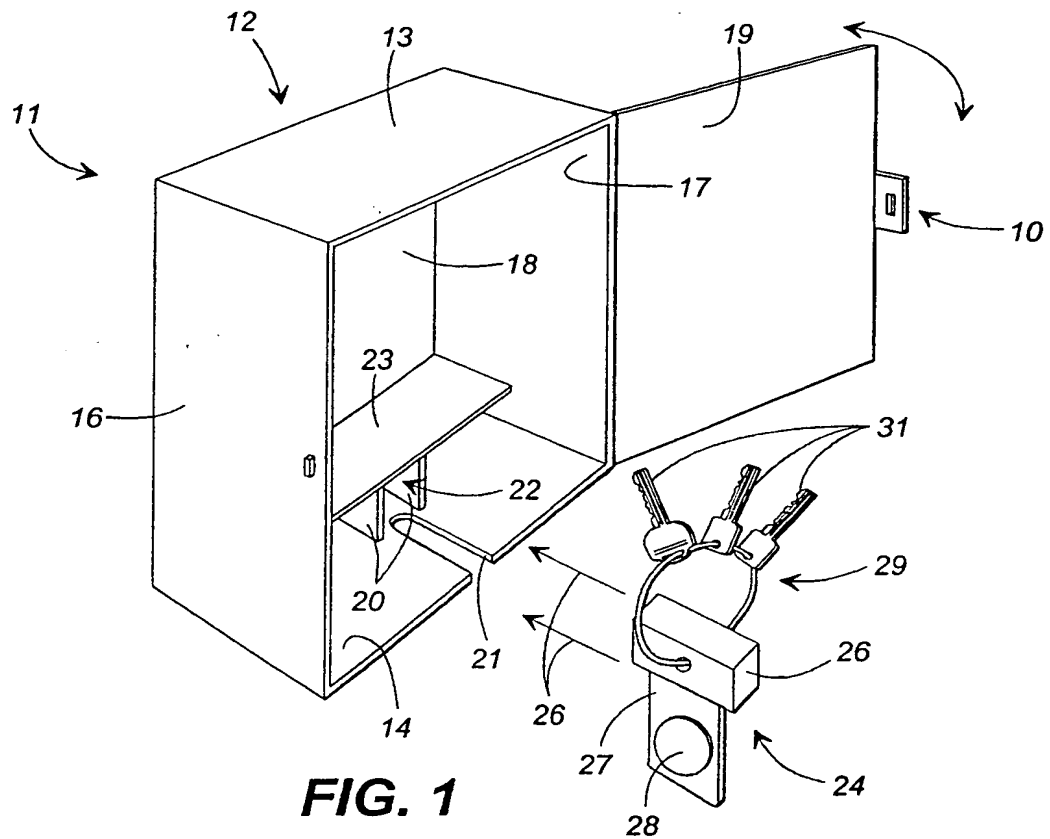
19. The method of claim 18 and further comprising transmitting the information relevant to the condition and use of the carrier to the main controller in real  
20 time as the carrier is opened and closed.

20

20. The method of claim 18 and wherein the information relevant to the condition and use of the carrier includes a record of the opening and closing of the panel of the carrier.

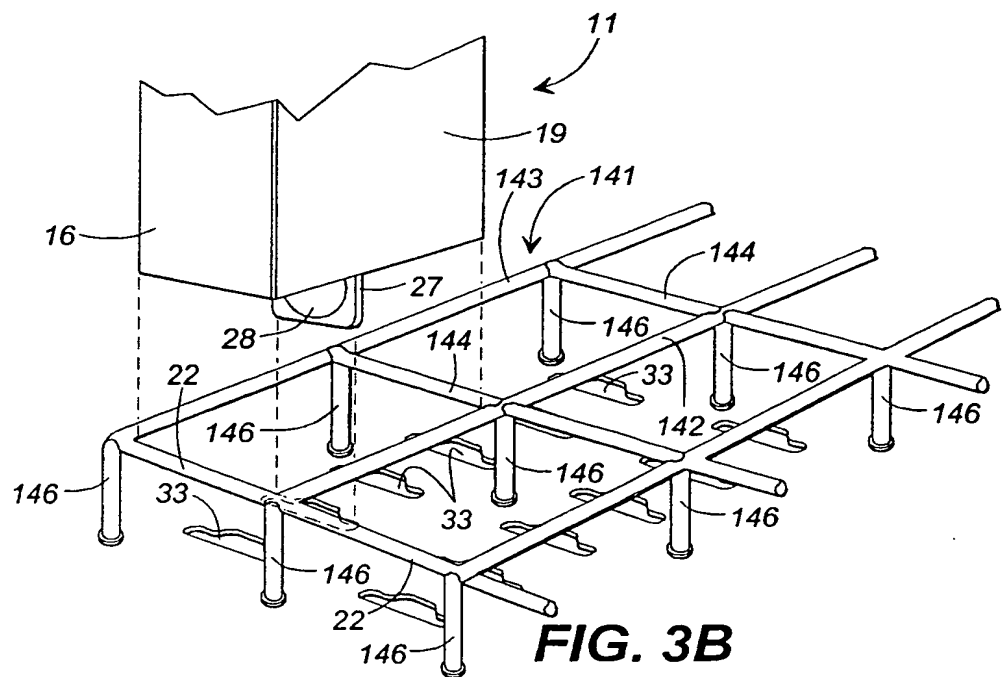
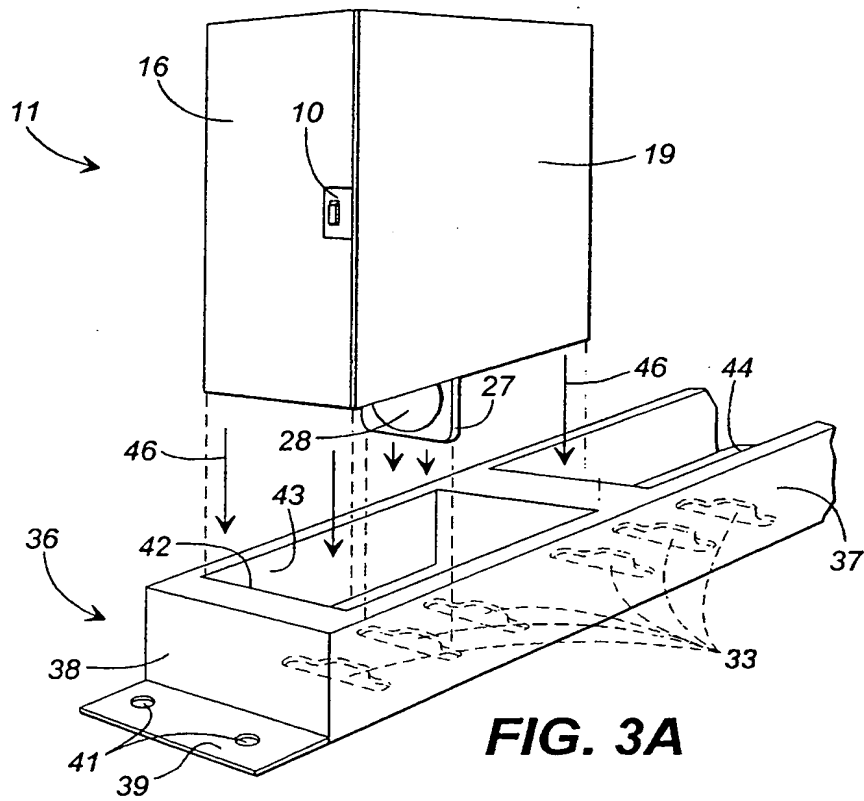
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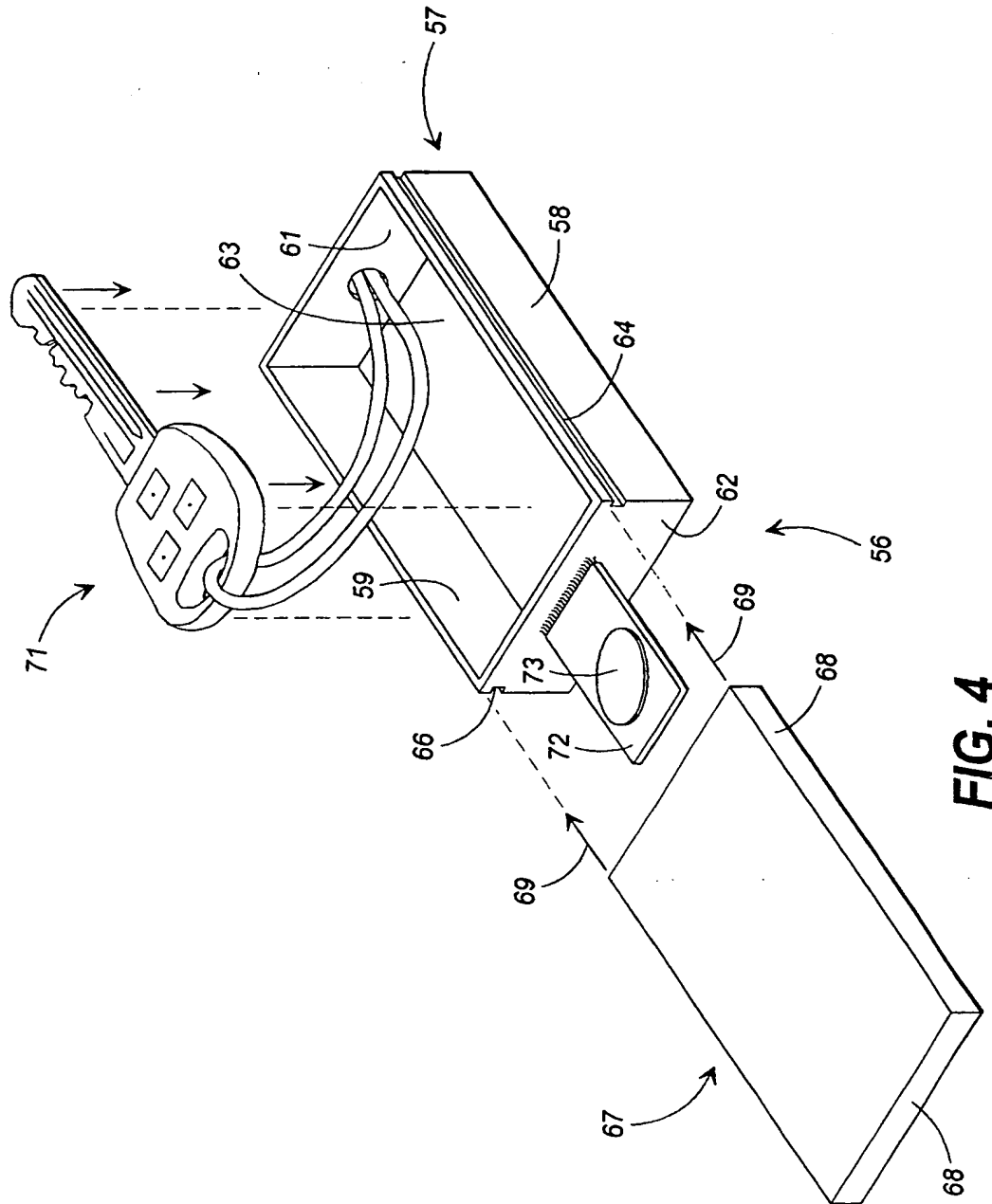
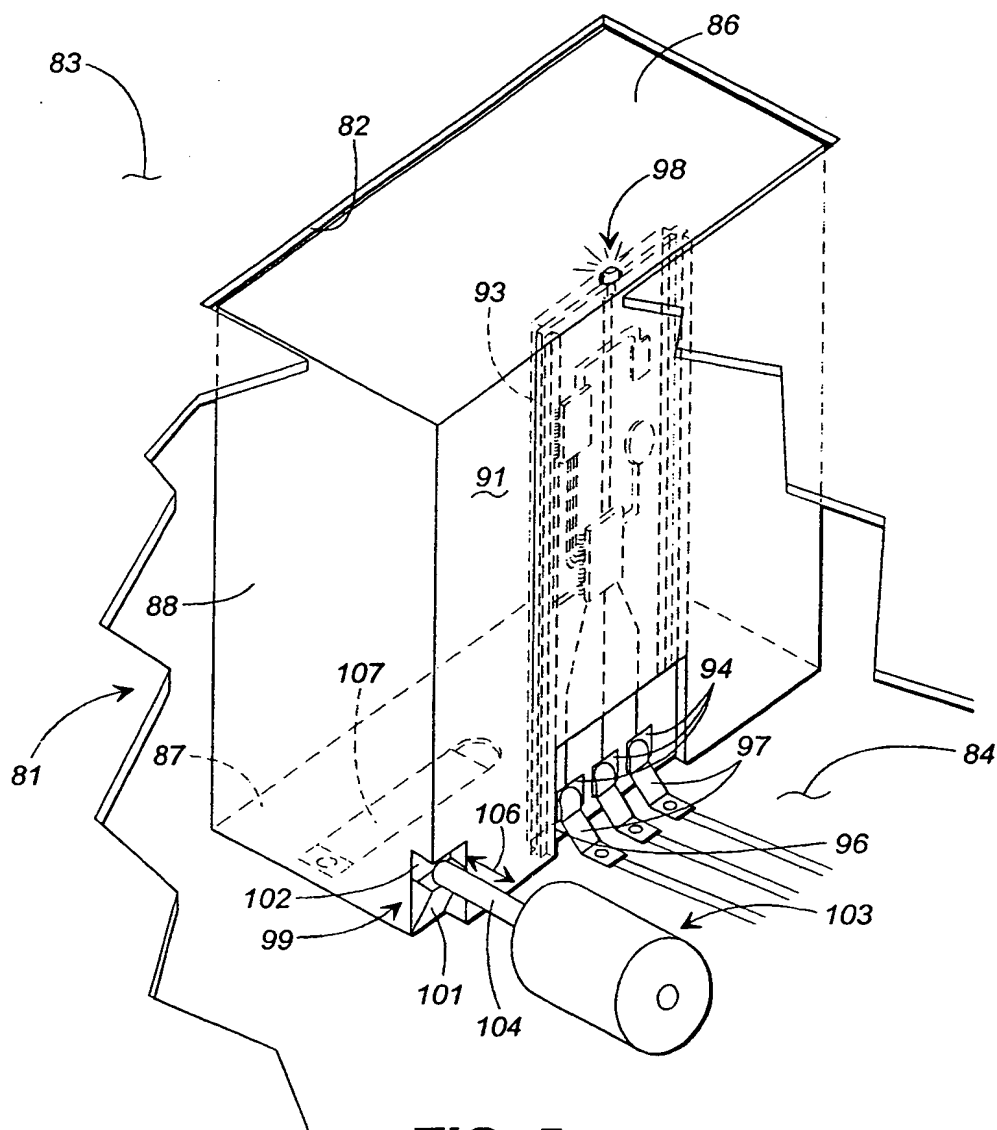


FIG. 4

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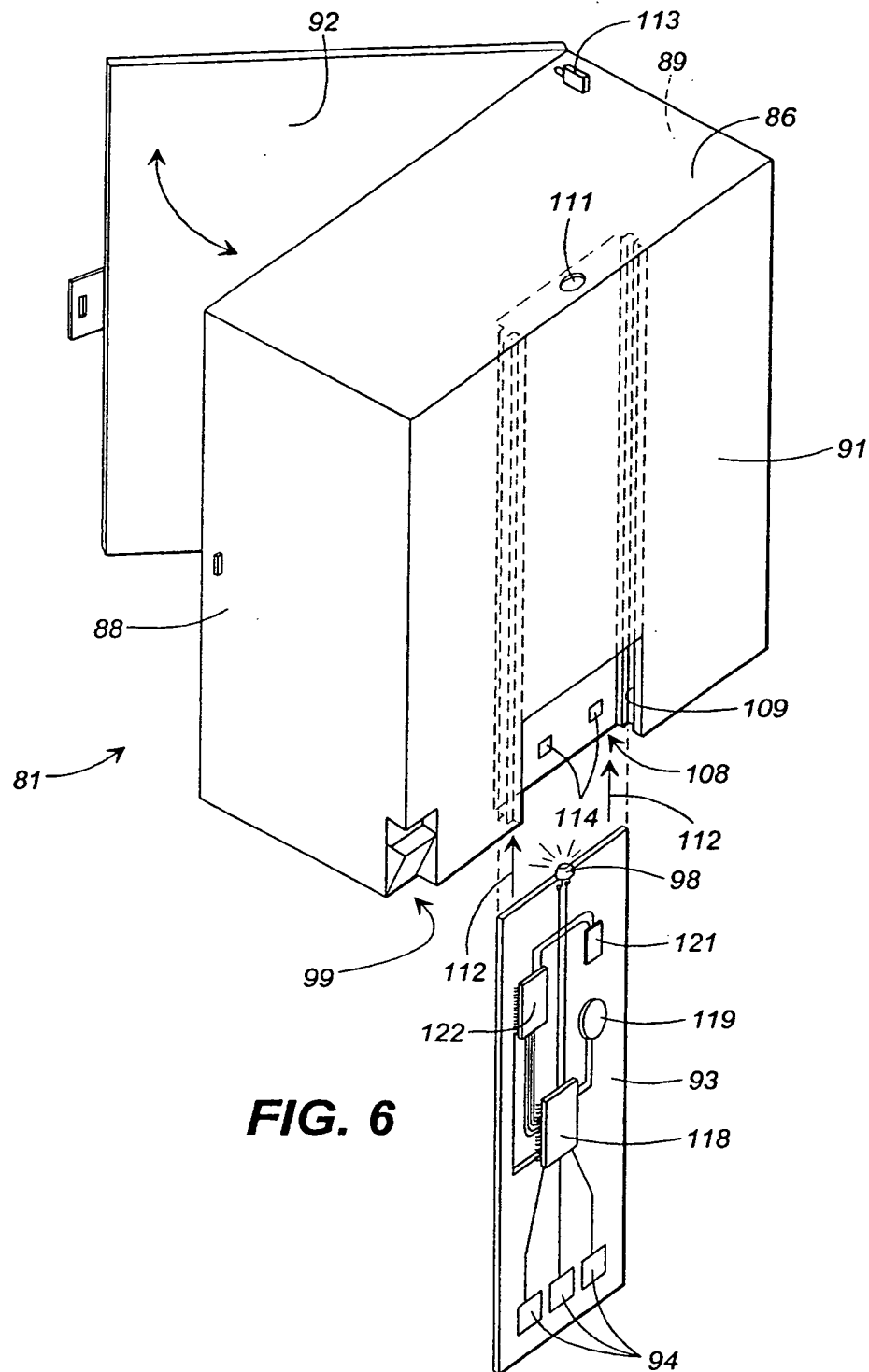


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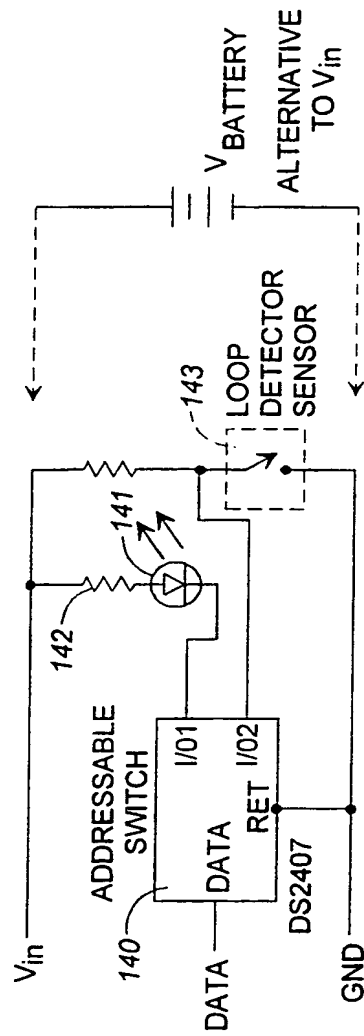
**FIG. 5**

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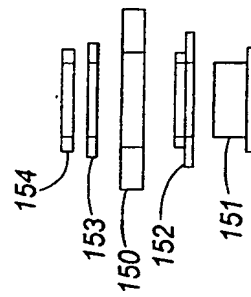
**FIG. 6**

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SCHEMATIC FOR A STORAGE BOX

**FIG. 7**



**FIG. 8**

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US99/20758

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : G08B 13/14

US CL : 340/568.1, 572.1, 572.8

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/568.1, 568.8, 572.1, 572.4, 572.8 and 572.9

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Please See Continuation of Second Sheet.	

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

03 NOVEMBER 1999

Date of mailing of the international search report

24 NOV 1999

Name and mailing address of the ISA/US  
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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/20758

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,549,170 A (SERRES et al) 22 October 1985, col. 2, lines 45-68, col. 3, lines 1-26, 47-68, col. 3, lines 12-56 and col. 5, lines 36-57.	1-20
A	US 5,528,222 A (MOSKOWITZ et al) 18 June 1996, col. 1, lines 21-57, col. 3, lines 9-29 and col. 7, lines 12-20.	1-20
A	US 4,673,915 A (COBB) 16, June 1987, col. 1, lines 32-55, col. 2, lines 1-20, col. 3, lines 10-68 and col. 4, lines 17-58.	1-20
A	US 4,595,922 A (COBB et al) 17 June 1986, col. 1, lines 55-68, col. 2, lines 1-16, 59-68, col. 3, lines 1-46, col. 4, lines 25-49.	1-20
A	US 5,533,079 A (COLBURN et al) 02 July 1996, col. 2, lines 32-67, col. 3, lines 1-14, col. 4, lines 7-14, col. 5, lines 15-40 and col. 10, lines 13-28.	1-20



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/20758

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

**BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING**

This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claims 1-16, drawn to an apparatus claim.

Group II, claims 17-20, drawn to a method claim.

The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I discloses an apparatus for controlling and tracking of an object, comprising at least on carrier for receiving and containing objects to be tracked; a memory device; conductive pads; a storage unit; an array of sets of electrical contacts and a controller.

Group II discloses a method of tracking access to an object, comprising the steps of: placing the object in a carrier; placing the carrier in a storage location; detecting and logging the presence and/or removal of the carrier at/from the storage.